

CLAIMS

What is claimed is:

1. A method facilitating bandwidth management across a plurality of access links, comprising
 - monitoring the data throughput at a plurality of interfaces in at least one routing system, wherein the plurality of interfaces are operably connected to respective access links; and
 - computing a virtual bandwidth limit based on the capacity of each of the plurality of interfaces and the data throughput detected at the plurality of interfaces.
2. The method of claim 1 further comprising
 - applying the virtual bandwidth limit to a bandwidth management device operably connected to a communication path between a network and the access links.
3. The method of claim 1 wherein the data throughput is inbound data throughput and the virtual bandwidth limit is an inbound virtual bandwidth limit.
4. The method of claim 1 wherein the data throughput is outbound data throughput and the virtual bandwidth limit is an outbound virtual bandwidth limit.
5. The method of claim 1 further comprising
 - comparing the aggregate bandwidth observed at the plurality of interfaces to the aggregate bandwidth observed at a bandwidth management device operably connected to a communication path between a network and the access links.
6. The method of claim 5 further comprising

adjusting the virtual bandwidth limit based on the difference between the aggregate bandwidth observed at the plurality of interfaces to the aggregate bandwidth observed at a bandwidth management device operably connected to a communication path between the network and the access links.

7. The method of claim 5 further comprising

reducing the virtual bandwidth limit if the aggregate bandwidth observed at the plurality of interfaces is greater than the aggregate bandwidth observed at a bandwidth management device operably connected to a communication path between the network and the access links.

8. The method of claim 5 further comprising

increasing the virtual bandwidth limit if the aggregate bandwidth observed at the plurality of interfaces is less than the aggregate bandwidth observed at a bandwidth management device operably connected to a communication path between the network and the access links.

9. The method of claim 2 further comprising

comparing the computed virtual bandwidth limit to a previously applied virtual bandwidth limit; and wherein the applying step is conditioned on the difference between the computed virtual bandwidth limit and the previously applied virtual bandwidth limit not exceeding a threshold value.

10. In a computer network environment comprising plurality of access links operably connected to respective interfaces of at least one routing system, wherein the plurality of interfaces are associated with a virtual access link, a method preventing overloading any of the interfaces, the method comprising

monitoring the bandwidth at the interfaces associated with the plurality of access links;

computing a bandwidth limit for the virtual access link based on the capacity of each of the plurality of interfaces and the bandwidth detected at the plurality of interfaces; and

applying the bandwidth limit in controlling data flows encountered at the plurality of interfaces associated with the virtual access link.

11. The method of claim 10 wherein the monitored bandwidth is the inbound bandwidth at the interfaces; and wherein the bandwidth limit is an inbound bandwidth limit.

12. The method of claim 10 wherein the monitored bandwidth is the outbound bandwidth at the interfaces; and wherein the bandwidth limit is an outbound bandwidth limit.

13. A data flow control device operative to prevent overloading any given interface in a plurality of interfaces, wherein the plurality of interfaces are associated with a virtual access link, comprising
a link monitoring module operative to
monitor the load at a plurality of interfaces associated with at least one routing system; and
compute a bandwidth limit for the virtual access link based on the capacity of each of the plurality of interfaces and the load detected at the plurality of interfaces; and
a flow control module operative to apply the bandwidth limit in controlling data flows encountered at the plurality of interfaces associated with the virtual access link.

14. The data flow control device of claim 13 wherein the load is the inbound bandwidth observed at the plurality of interfaces, and the bandwidth limit is an inbound bandwidth limit.

15. The data flow control device of claim 13 wherein the load is the outbound bandwidth observed at the plurality of interfaces, and the bandwidth limit is an outbound bandwidth limit.
16. The data flow control device of claim 13 wherein the load is the exponential weighted moving average of the inbound bandwidth observed at the plurality of interfaces, and the bandwidth limit is an inbound bandwidth limit.
17. The data flow control device of claim 13 wherein the load is the exponential weighted moving average of the outbound bandwidth observed at the plurality of interfaces, and the bandwidth limit is an outbound bandwidth limit.
18. The data flow control device of claim 13 further comprising
a traffic classification database operative to associate traffic classes to data flows; and wherein the flow control module is operative to apply disparate bandwidth utilization policies to data flows depending on their respective traffic classes.
19. A system operative to prevent overloading any given interface in a plurality of interfaces, wherein the plurality of interfaces are associated with a virtual access link, comprising
a routing system operative to route data packets received at a given interface; wherein the routing system comprises at least a first, second and third interface; wherein the first and second interfaces are respectively coupled to first and second access links; and
a data flow control device operatively connected to the routing system via the third interface;
wherein the data flow control device comprises:
a link monitoring module operative to

- monitor the load at the first and second interfaces; and
- compute a bandwidth limit for the virtual access link based on the capacity of, and the load detected at, the first and second interfaces; and
- a flow control module operative to apply the bandwidth limit in controlling data flows traversing the first and second access links.

20. The system of claim 19 wherein the load is the inbound bandwidth observed at the first and second interfaces, and the bandwidth limit is an inbound bandwidth limit.

21. The system of claim 19 wherein the load is the outbound bandwidth observed at the first and second interfaces, and the bandwidth limit is an outbound bandwidth limit.